

# Aerosol Chemical Composition and CCN Properties Measured on the DOE G1 during 2005 MASE

Yin-Nan Lee, John Jayne, Liz Alexander, James Hudson, Stephen Springston, Gunnar Senum, John Hubbe, Jian Wang, Lawrence Kleinman, Peter Daum

## **Goal:**

*To determine the chemical composition of aerosol particles and its impact on the cloud condensation nuclei properties of these particles in a coastal marine environment characterized by frequent stratus cloud formation.*

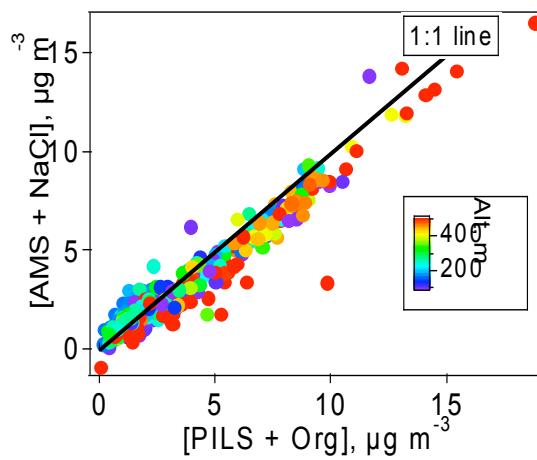
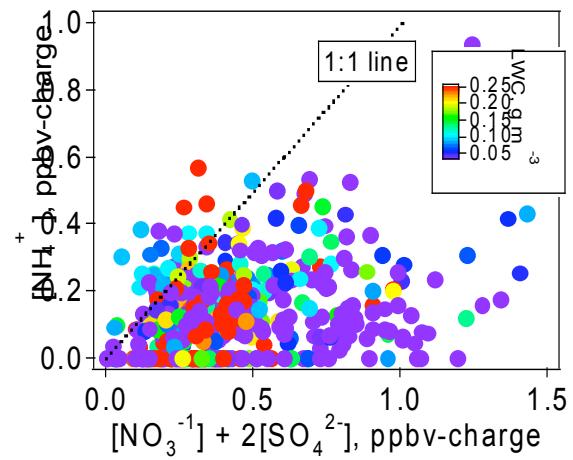
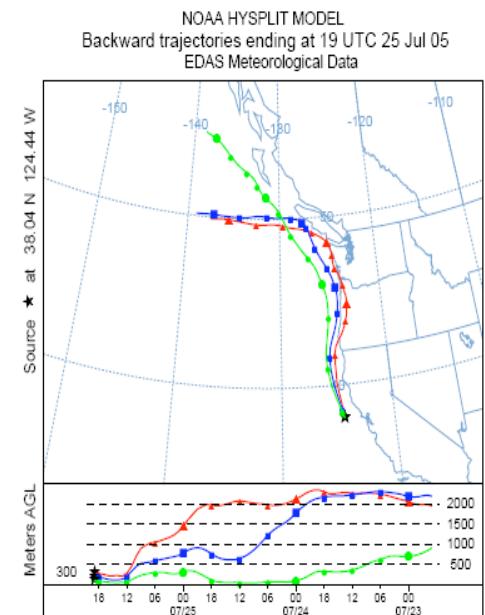
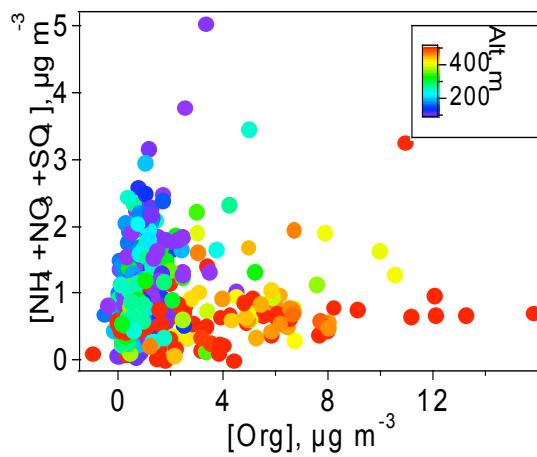
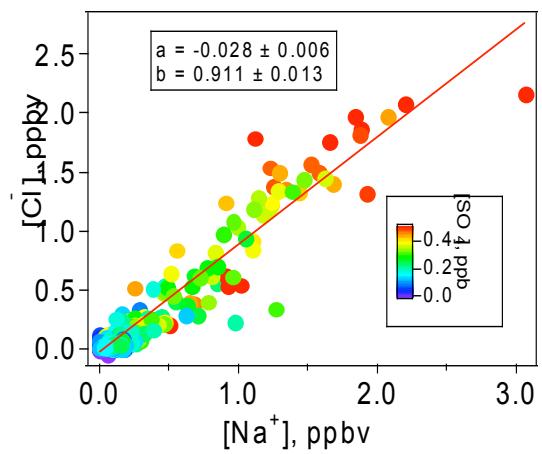


# Measurement Data used in this Analysis

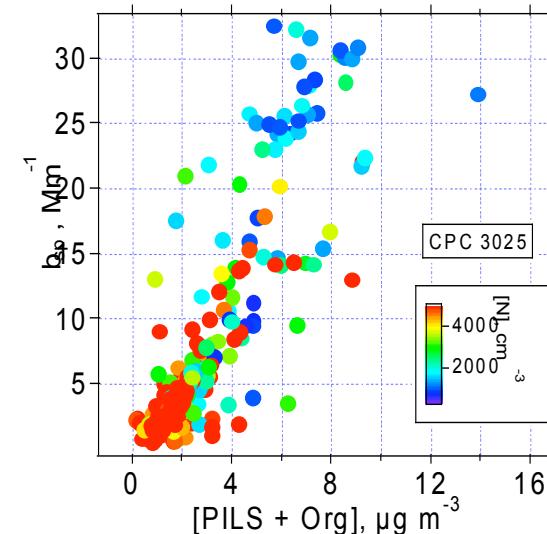
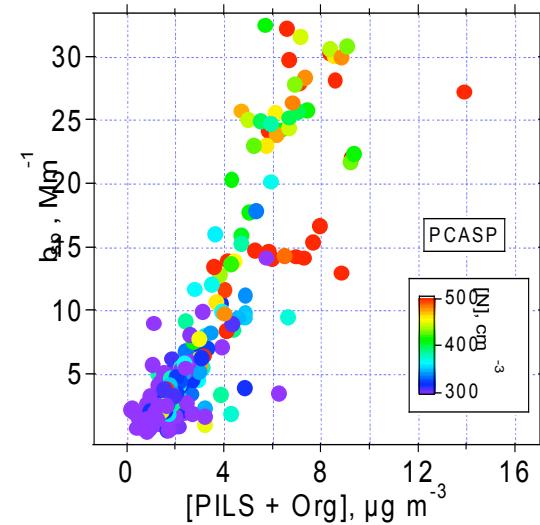
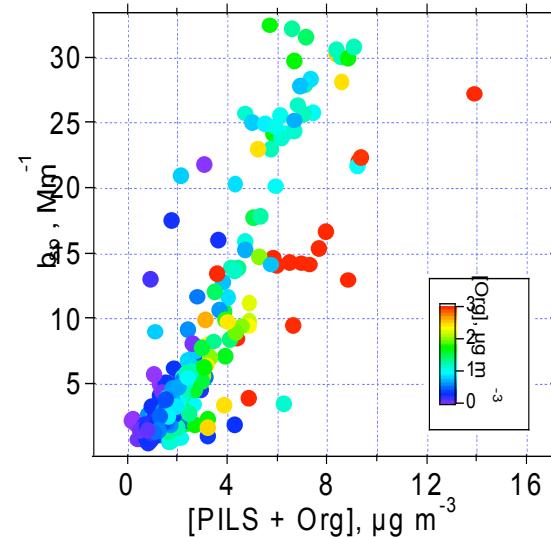
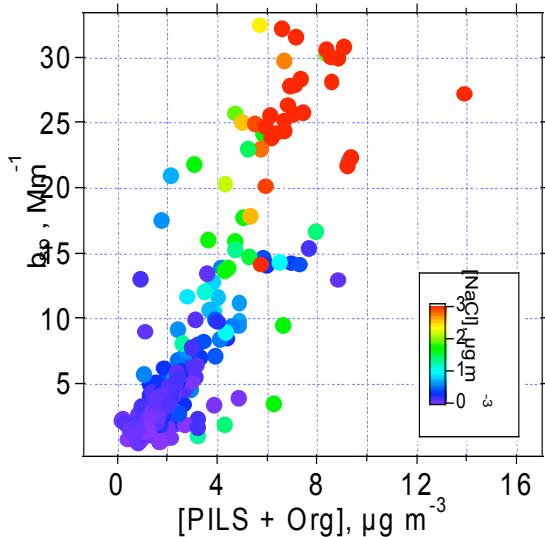
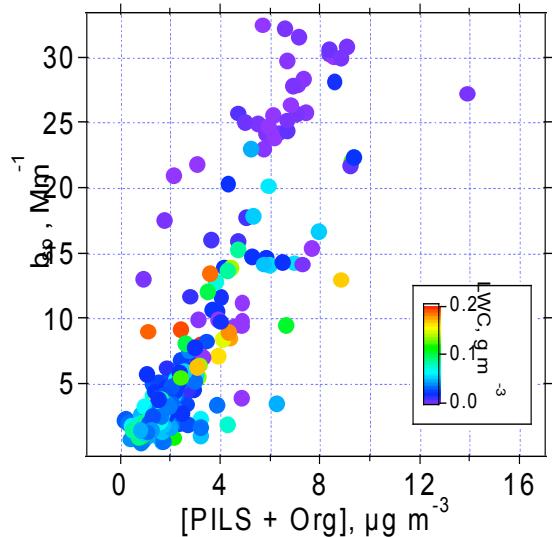
<b><i>Techniques</i></b>	<b><i>Quantities</i></b>	<b><i>Time resolution</i></b>	<b><i>Limit of detection</i></b>
Aerosol Mass Spectrometer (AMS)	Cl <sup>-</sup> , NH <sub>4</sub> <sup>+</sup> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , Org	30 s	0.05 µg/m <sup>3</sup>
Particle-into-Liquid Sampler-Ion Chromatography (PILS-IC)	NH <sub>4</sub> <sup>+</sup> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , Na <sup>+</sup> , Cl <sup>-</sup> , MS <sup>2-</sup> , Mg <sup>2+</sup> , K <sup>+</sup> , Ca <sup>2+</sup>	240 s	0.15 µg/m <sup>3</sup>
DRI CCN Spectrometer	CCN concentration at S (%) = 0.02, 0.04, 0.06, 0.08, 0.1, 0.2, 0.3, 0.6, 1.0	1 s	~30
Passive Cavity Aerosol Spectrometer Probe (PCASP)	Size distribution between 0.1 and 3 µm	1 s	~10
DMT CCN Counters	CCN concentrations at S (%) = 0.08 and 0.2	1 s	~30
BNL Tandem Differential Mobility Analyzer (TDMA)	Number-size distribution between 0.016 and 0.44 µm	~60 s	~10



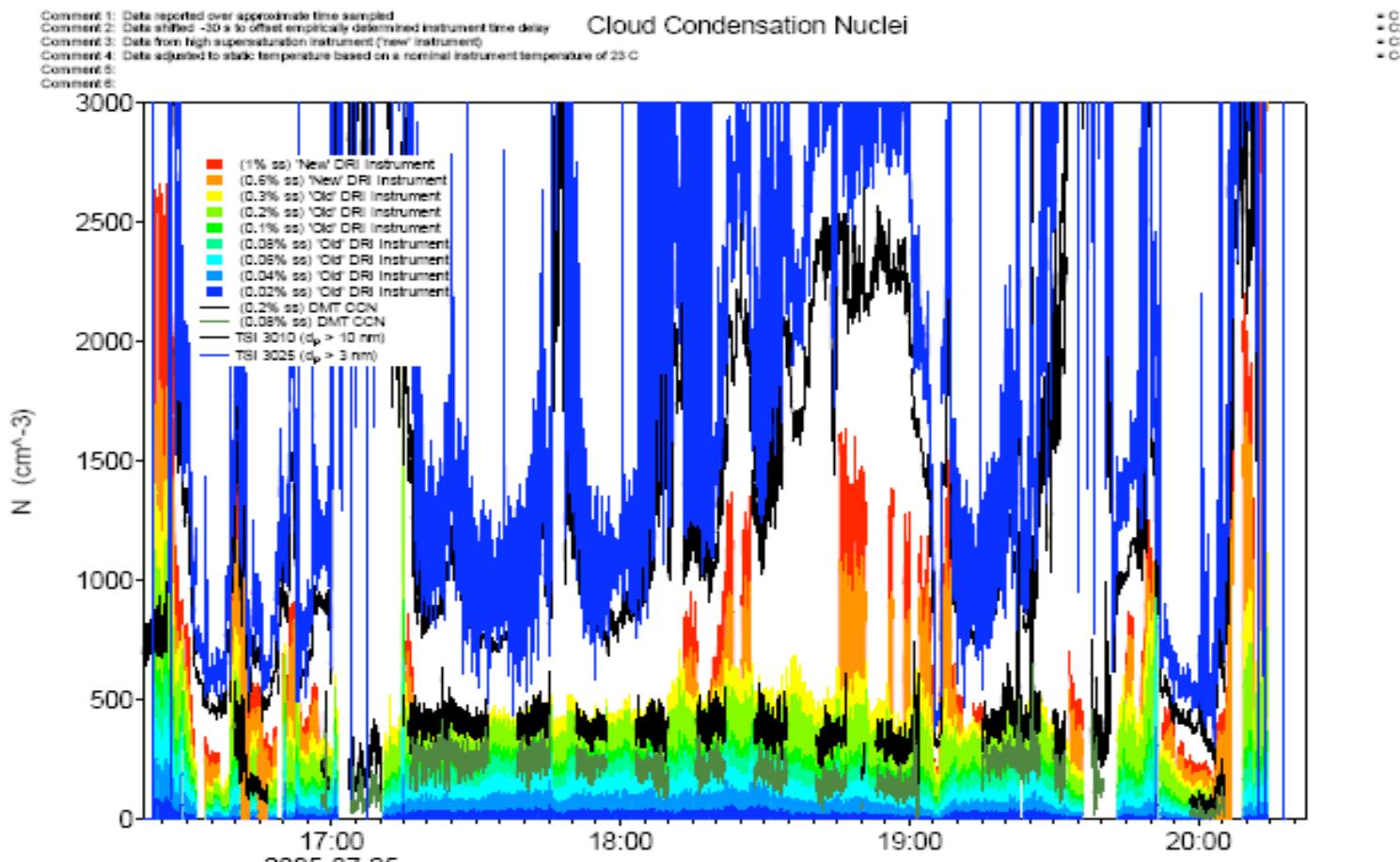
# Relationships Among Major Aerosol Chemical Components (Marine)



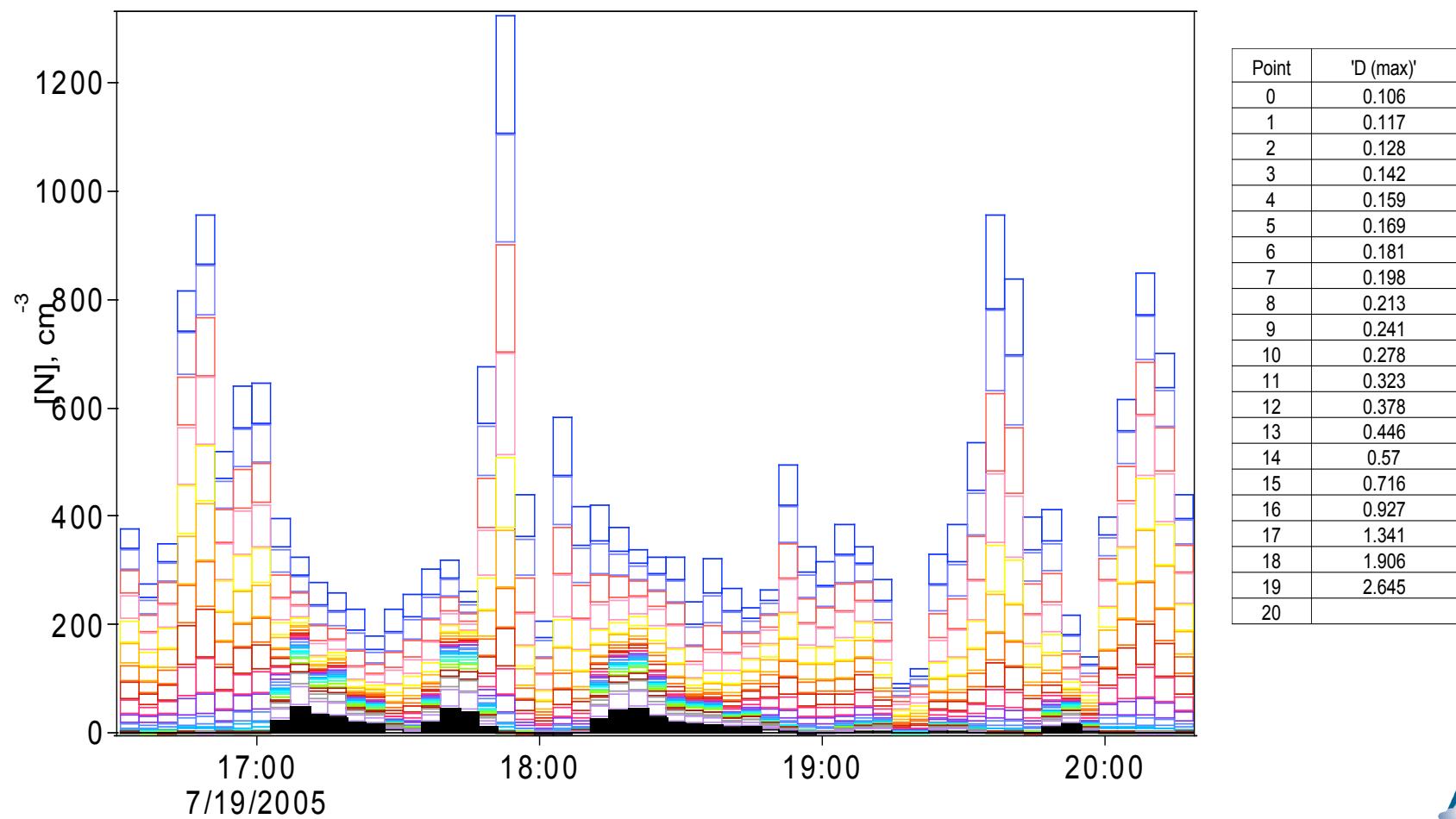
# Aerosol Chemical Composition and Light Scattering Coefficient within Marine Boundary Layer (< 400 m)



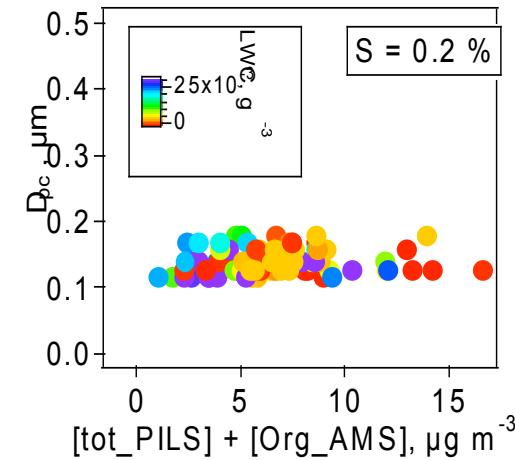
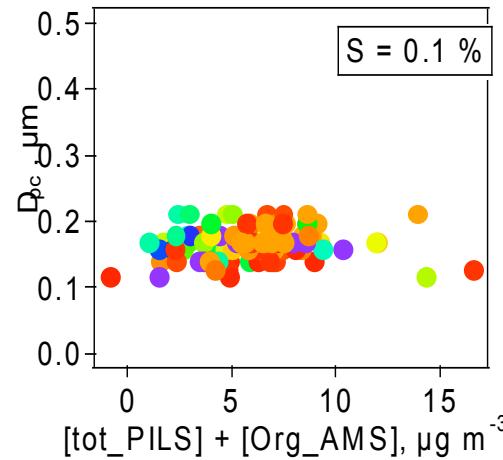
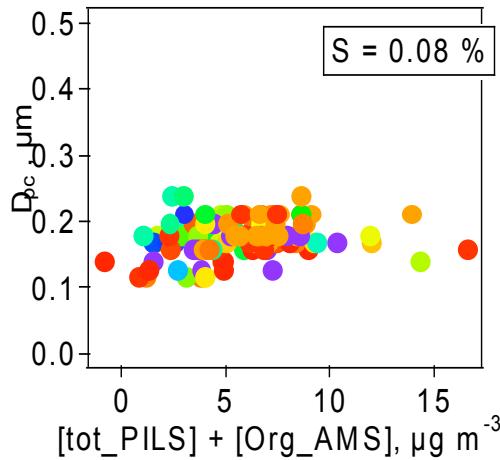
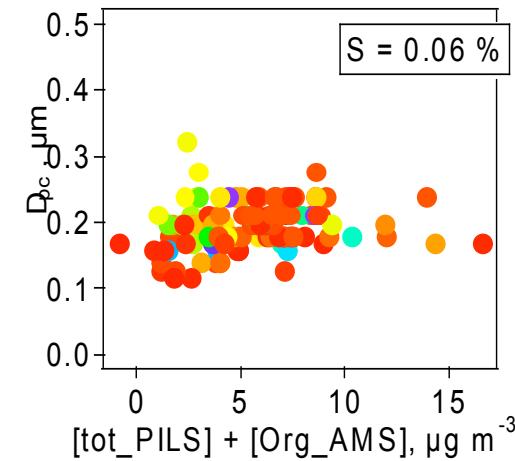
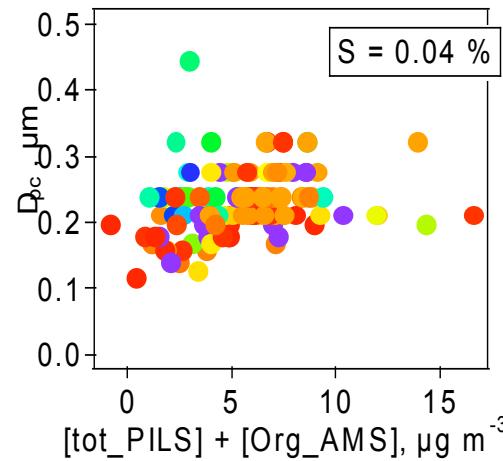
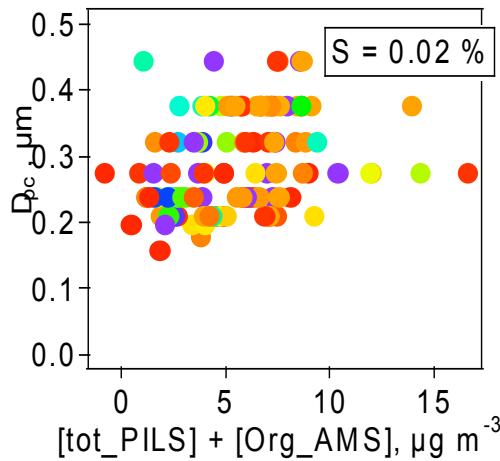
# CCN Concentrations Measured on 7/25/06



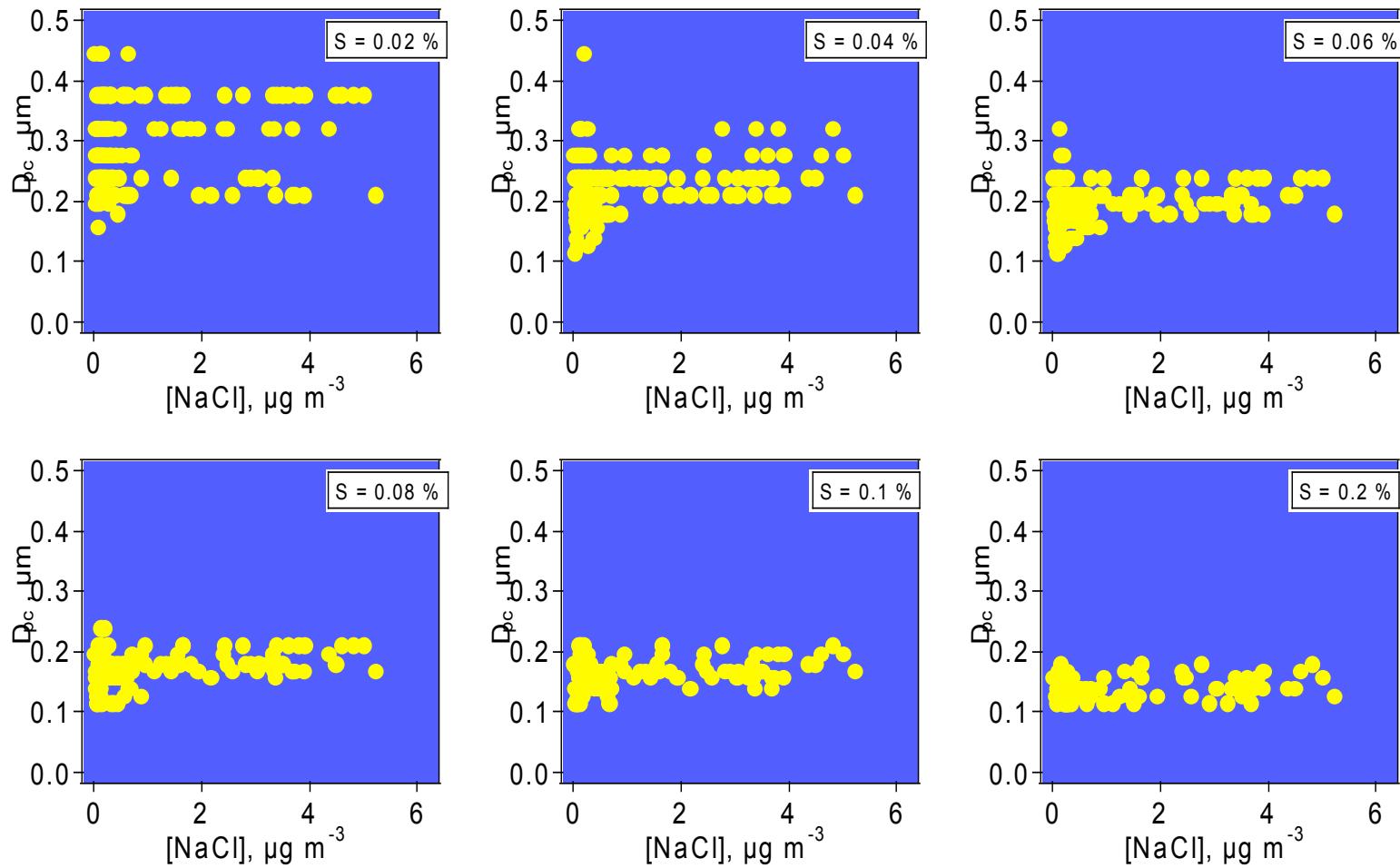
# Size Distribution of Accumulation Mode Particles (averaged to PILS time base)



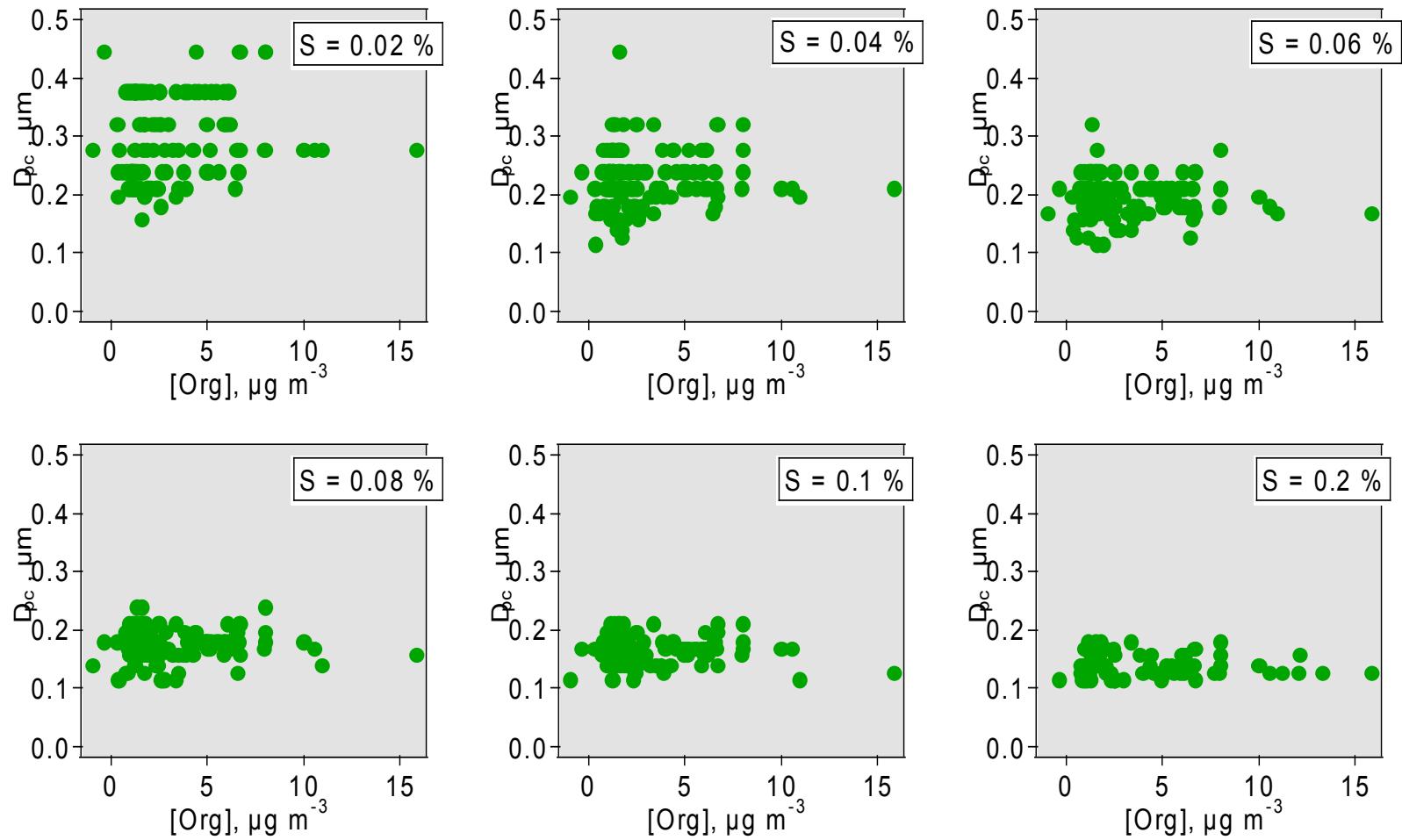
# Dependence of $D_{pc}$ on Total Aerosol Mass Concentration as a Function of Supersaturation ( $LWC < 0.03 \text{ g m}^{-3}$ )



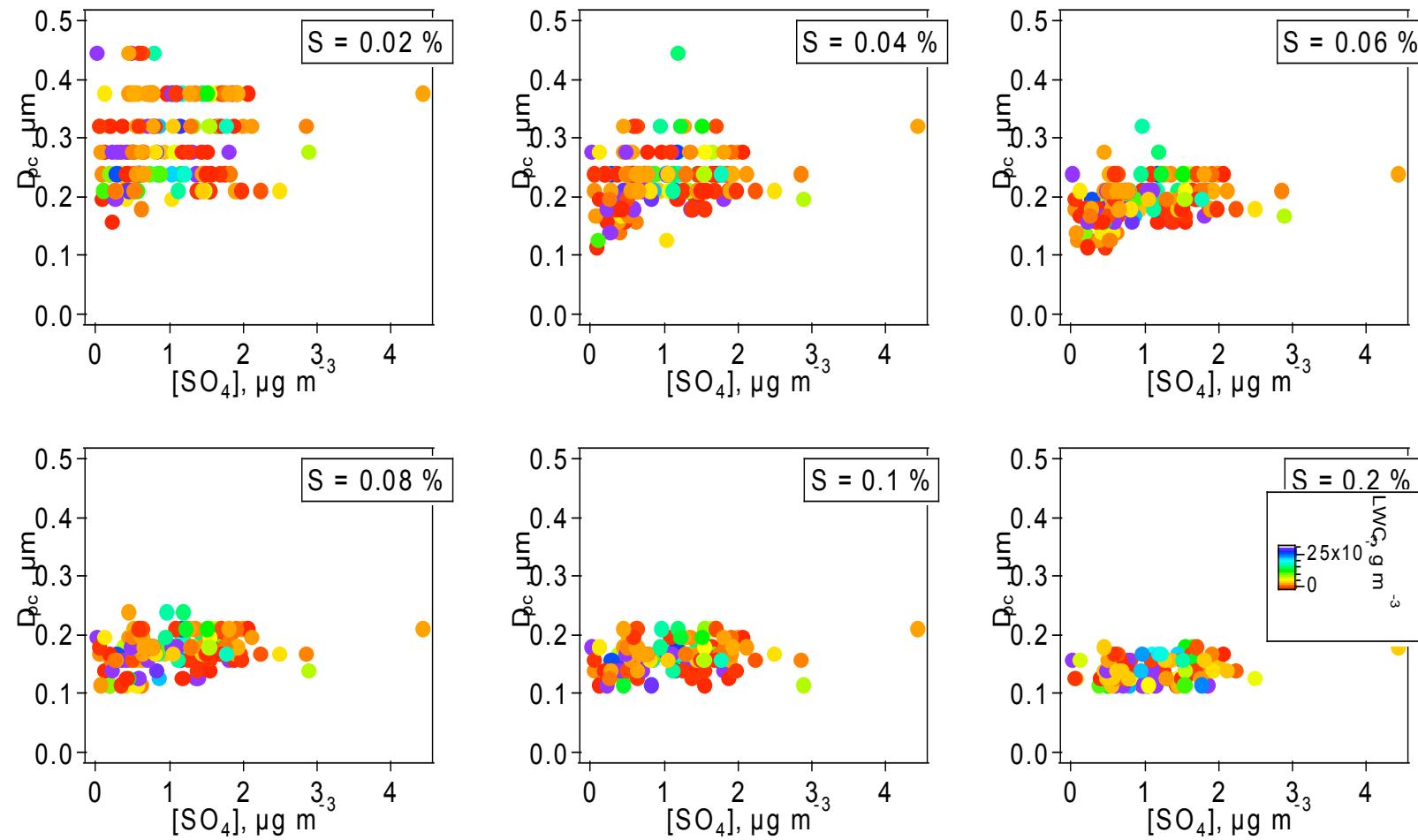
# Dependence of $D_{pc}$ on NaCl Mass Concentration as a Function of Supersaturation (LWC < 0.03 g m<sup>-3</sup>)



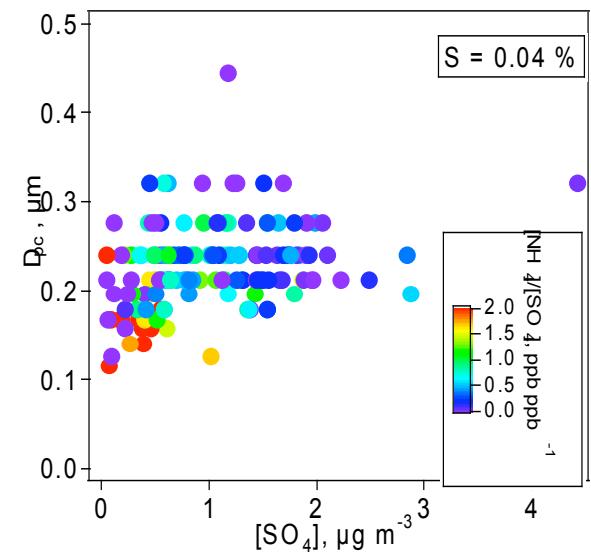
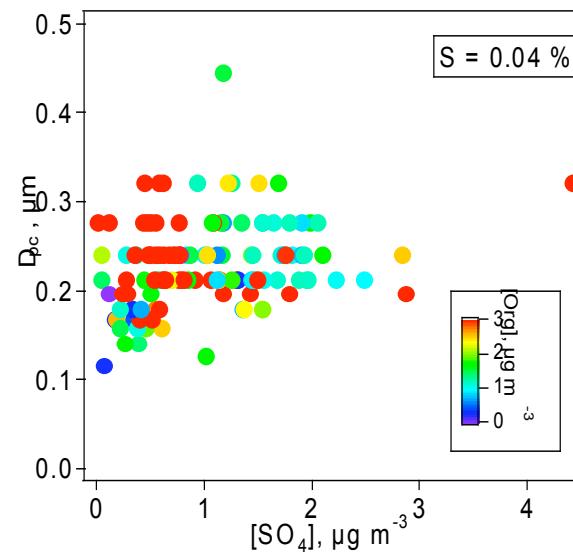
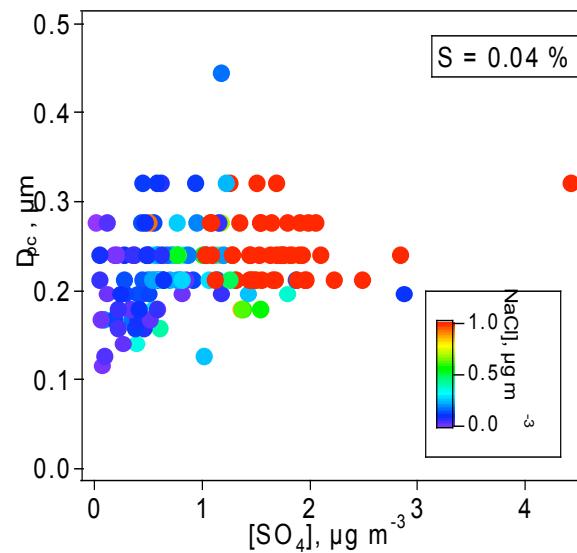
# Dependence of $D_{pc}$ on Organic Mass Concentration as a Function of Supersaturation (LWC < 0.03 g m<sup>-3</sup>)



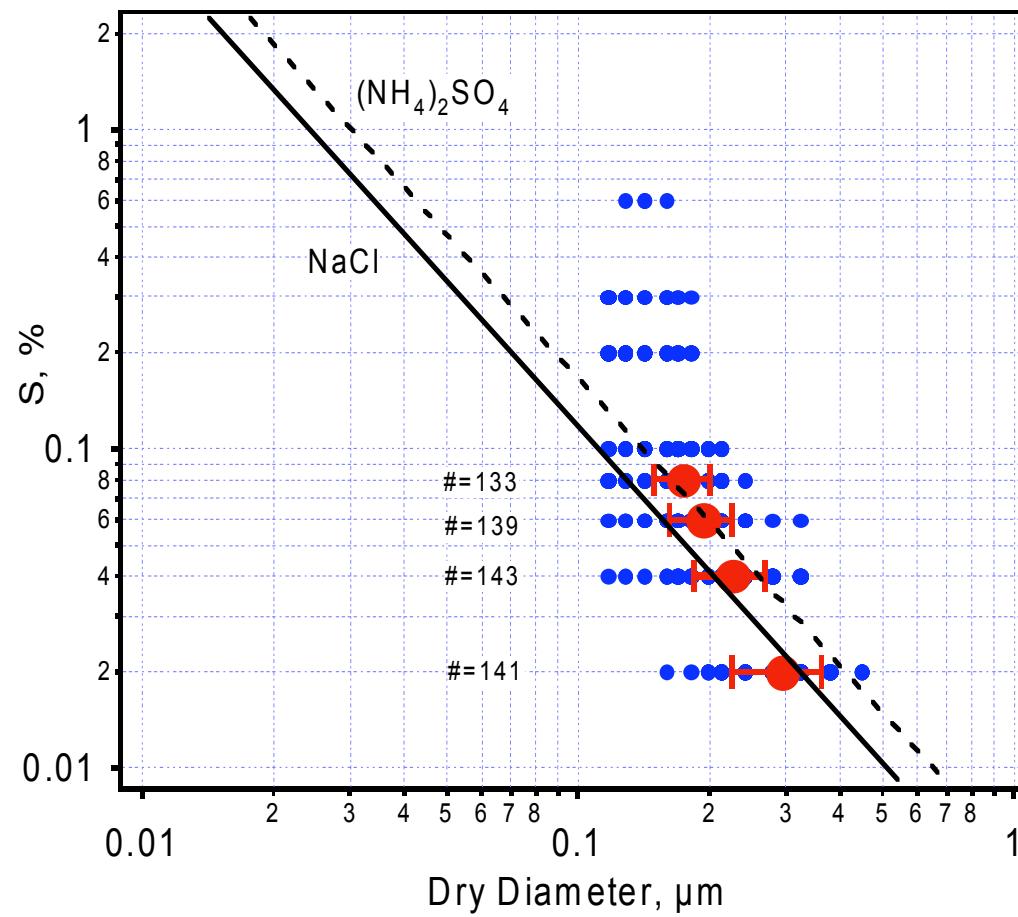
# Dependence of $D_{pc}$ on $\text{SO}_4^{2-}$ Concentration as a Function of Supersaturation ( $LWC < 0.03 \text{ g m}^{-3}$ )



# Dependence of $D_{pc}$ on Chemical Composition and Degree of Neutralization



# Critical supersaturation observed for Marine Aerosols as a function of size during 2005 MASE



# Summary

- Aerosol chemical components,  $\text{NH}_4^+$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ ,  $\text{Na}^+$ ,  $\text{Cl}^-$ , and organics, were quantified for marine aerosol particles ( $d_p < 1.5 \mu\text{m}$ ) using the PILS-IC and the AMS on the G-1 during 2005 MASE.
- Marine aerosols within  $\sim 200$  km of northern California coast contain an important terrestrial contribution.
- CCN spectra allowed  $D_{pc}$  to be determined from aerosol size distribution.
- At  $S_c \sim 0.06\%$  characteristic of marine stratus, the observed  $D_{pc}$  was the same as predicted for  $(\text{NH}_4)_2\text{SO}_4$  and was unaffected by organics.
- At  $S_c > 0.06\%$ ,  $D_{pc}$  showed a departure from calculated values for  $(\text{NH}_4)_2\text{SO}_4$ .
- The observed  $D_{pc}$  was not strongly affected by the concentration of individual chemical components, but appear to show a positive dependence on aerosol acidity, being more pronounced at lower  $S_c$ .

